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PENSOFT.

Two new records of the fern genus *Lindsaea* Dryand. ex Sm. (Lindsaeaceae) from Panama

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Abstract. We present the first records of *Lindsaea leprieurii* Hook. and *Lindsaea angustipinna* A.Rojas & Tejero from Panama. Images, taxonomic comments, conservation assessments, and geographic notes are provided.

Keywords. Central America, floristics, geographical distribution, Polypodiopsida, taxonomy

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Introduction

Lindsaeaceae comprises about 200 species of fern and is widely distributed in the tropics, with numerous species ranging into the subtropics in temperate South America, East Asia, and New Zealand (Kramer 1957). Currently, this family includes seven genera: *Sphenomeris* Maxon, *Odontosoria* Fée, *Lindsaea* Dryand. ex Sm., *Osmolindsaea* (K.U. Kramer) Lehtonen & Christenh., *Nesolindsaea* Lehtonen & Christenh., *Tapeinidium* (C. Presl) C. Chr., and *Xyropteris* K.U. Kramer, whose monophyly is supported by molecular studies (Lehtonen et al. 2010; Christenhusz et al. 2011; PPG I 2016).

Lindsaea is a pantropical genus characterized by having short petioles, abaxially keeled rachises, broad rachis sulcation, twice-ordered laminar venation, and presence of sori towards the margin of the segments, as well as having indusia usually opening towards the margin (Kramer 1957; Lehtonen et al. 2010). *Lindsaea* currently comprises approximately 150 species which are distributed in 13 clades (only four of these clades are exclusively Neotropical) (Lehtonen et al. 2010). At present, the Neotropical region comprises more than 50 species, of which 17 occur in Mesoamerica (Rojas-Alvarado and Tejero-Díez 2017) and 13 in Panama (Correa et al. 2004, with additions by Rojas-Alvarado and Tejero-Díez 2017).

During curation and revision of the fern collections in the PMA Herbarium, we identified two species of the genus *Lindsaea*, *L. leprieurii* Hook. and *L. angustipinna* A. Rojas and Tejero, which represent new records for the flora of Panama. With these additions, Panama now has 15 species of *Lindsaea*.

Methods

We confirmed the studied PMA herbarium specimens by comparing them with type material housed at B, CR, K, MO, and USJ (acronyms according to Thiers 2022). In addition, type specimens were examined online by consulting the JSTOR Global Plants database (JSTOR 2022). Morphological information was obtained from Kramer (1957) and Rojas-Alvarado and Tejero-Díez (2017), with modifications based on the studied herbarium specimens. Distribution data were taken from GBIF (2022) and Tropicos (2022).

The conservation assessments follow B criterion of the International Union for the Conservation of Nature (IUCN Standards and Petitions Committee 2019) and are based on the number of locations (geographical or

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ecological areas of occurrence), the extent of occurrence (EOO), and/or the area of occupancy (AOO). The values used in IUCN Criteria were calculated using the GeoCAT tool (Bachman et al. 2011), and the Rapid Least Concern web application (Bachman et al. 2020).

Results

***Lindsaea angustipinna* A. Rojas & Tejero**, Phytotaxa 296(2): 149–150. 2017. (Rojas-Alvarado and Tejero-Díez 2017).

Figure 1

Type. Costa Rica. Guanacaste: Liberia, Parque Nacional Guanacaste, sendero al volcán Cacao, parte alta, 10°55′58″N, 085°27′41″W, 350–1300 m elev., 7 August 2007, A. Rojas and G. Araya 7752 (holotype CR!, isotypes MO!, USJ!).

New records. PANAMA – **Chiriquí** • Distrito de Gualaca, Corregimiento de Hornito, Reserva Forestal Fortuna; [08°43′20″N, 082°14′21″W]; 1200 m elev.; 25.V. 2016; J. Viana 376 (PMA 0113906) – **Veraguas** • Distrito de Montijo, Isla de Coiba, Playa Hermosa, tomando por el arroyo y subiendo hacia la falla, bosque secundario, área sombreada; [07°30′22″N, 081°50′23″W]; 30 m elev.; 30.VIII.1995; B. Araúz et al. 189 (PMA 043784).

Global distribution. Nicaragua, Costa Rica, and Panama.

Conservation status. This species is known from six locations of which five are currently in protected areas (Fortuna Forest Reserve and Coiba National Park in Panama; La Amistad International Park between Costa Rica and Panama; Zona Protectora El Chayote, Juan Castro Blanco National Park, Cacao Biological Station, and Pitilla Biological Station in Costa Rica; Biosphere Reserve in Volcan Maderas in Nicaragua). Considering the relatively wide natural distribution of this species (EOO = 35,154 km^2) as well as the fact that most of its occurrences are in protected areas, we provisionally assessed *L. angustipinna* as Least Concern.

Description. Perennial terrestrial herb, rhizomes short-creeping, with fronds 1–3(–5) mm between them; rhizome scales 1–1.5 × 0.2–0.3 mm, dark brown to reddish brown, entire, crisped in the middle portion; fronds (15–)17–30 cm long, with vertical stipes, arching or inclined on the blades; stipes (8–)9–21 cm long, at least the basal half atropurpureous; blades 9–19 × (2–)2.5–4.5 cm, 1-pinnate, lanceolate-oblong to oblong; rachises stramineous or sometimes basally dark, quadrangular, with stramineous wings; pinnae (0.9–)1.2–2.1 × (0.5–)0.6–0.9 cm, commonly 2.5–3.5× longer than wide, (5–)12–20 pairs, trapezoidal, perpendicular to rachis, continuous to distant a half of pinna broad (rarely more distant at blade base), the apical segments 2–3× longer than wide, hastate and lanceolate; sori continuous along acroscopic and distal sides of pinnules, indusia 0.2–0.3 mm broad, dark brown, entire to lobulate.

***Lindsaea leprieurii* Hook.**, Sp. Fil. 1: 208. 1847. (Hooker 1846).

Figure 2

Type. French Guiana [Guyana], F. Leprieur s.n. (holotype K!; isotype B!).

New record. PANAMA – **Coclé** • El Santísimo, Llano Grande; 08°41′28″N, 080°26′48″W; 520 m elev.; 6.XI. 2001; J. Mendieta 723 (PMA 93152).

Global distribution. Costa Rica, Panama, Colombia, Venezuela, Suriname, Guyana, and French Guiana.

Conservation status. *Lindsaea leprieurii* has a widespread geographical distribution (EOO = 3,244,652 km^2), and it has no serious threats. We consider this species to be Least Concern.

Description. Perennial terrestrial herb, rhizomes short, ca. 1–2 mm in diameter, with fronds 1–3 mm between them; rhizome scales ca. 1 × 0.2–3 mm, reddish brown; fronds 14–22 cm long; stipes 3.5–8 cm long, atropurpureous to brown or blackish, abaxially terete or angular and somewhat winged near the apex; blades 3–16 × 2.2–3 cm, 1-pinnate, dark brownish green, with weakly reduced distal segments and subconform apical segments (the longer segments more than 2× longer than wide); rachises atropurpureous to brown or blackish; pinnae 0.9–3 × 0.3–1 cm, commonly 2–3× longer than wide (the longer segments generally more than 2× longer than wide), (1–)7–17 pairs, entire or repand at acroscopic side, curved down (acute at apex) at basiscopic side; sori continuous only along acroscopic side of pinnules.

Discussion

Previous studies on *Lindsaea* (Rojas-Alvarado and Tejero- Díez 2017) stated that *L. angustipinna* occurred only in Nicaragua and Costa Rica at elevations between 900 and 1350 m. The specimen from the Province of Chiriquí was collected at a moderate elevation (1200 m) but plants from Coiba Island were collected from sea level to 416 m elevation at most. The Coiba Island specimens are unusual in that they are smaller overall and have notably smaller blades.

Lindsaea angustipinna resembles to *L. lancea* (L.) Bedd. Both species have entire or repand acroscopic margins, continuous sori (only present along acroscopic side of segments), triangular to rectangular or similar segments that are (in longer segments) twice as long as wide, weakly reduced distal segments (at least 75 % the size of proximal segments), and subconform apical segments (0.8–2.0 cm broad at base). *Lindsaea angustipinna* differs from *L. lancea* in having stipes with at least their lower half atropurpureous (vs. completely stramineous), 1-pinnate (vs. 2-pinnate) blades, and segments 2.5–3.5× longer than wide (vs. 1.8–2.5×). Although the geographic distribution of *L. angustipinna* overlaps with that of *L. lancea* (known from Mexico, Mesoamerica, Antilles, Colombia, Ecuador, Peru, Bolivia, Venezuela, Trinidad, Suriname, Brazil, and Paraguay),

Figure 1. Herbarium specimen of *Lindsaea angustipinna* from Chiriquí, Panama.

Figure 2. Geographical distribution of *Lindsaea angustipinna*. △ = new records from Panama; O = previously known records.

no hybrid specimens with intermediate morphological characteristics have been collected, which suggests that these species are reproductively separate.

Lindsaea leprieurii was previously reported from Costa Rica and northern South America (Rojas-Alvarado and Tejero-Díez 2017), which suggests that its presence in Panama was to be expected. The only representative specimen of this species in Panama (Mendieta 723 PMA) was previously identified as *L. falcata* Dryand., a species that currently does not occur in the Central American region (Rojas-Alvarado and Tejero-Díez 2017).

In his taxonomic monograph for the genus *Lindsaea*, Kramer (1957) considered *L. leprieurii* and *L. falcata* (based on Rosenstock 1906) as varieties of *L. lancea*, arguing that the latter is a very polymorphous species. However, a molecular phylogenetic study by Lehtonen et al. (2010), where samples of three varieties [*L. lancea* var. *falcata* (Dryand.) Rosenst., *L. lancea* var. *leprieurii* (Hook.) K.U. Kramer, and *L. lancea* var. *submontana* Boudrie & Cremers] were included, demonstrated that *L. lancea* represents a non-monophyletic entity. Rojas-Alvarado and Tejero-Díez (2017), in their taxonomic treatment for Mesoamerican species, considered this last notion and recognized *L. leprieurii* and *L. falcata* (restricted to South America) as taxa distinct from *L. lancea*.

Lindsaea leprieurii differs from *L. falcata* in having blackish (vs. reddish-brown) stipes, dark green blades when dry (vs. pale green to green blades), and hastate apical pinnae (vs. deltate to deltate-lanceolate pinnae). *Lindsaea leprieurii* also differs from *L. lancea* in having 1-pinnate blades (vs. frequently 2-pinnate), pinnules up to 3× as long as wide (vs. ca. 2–2.5× as long as wide), distal pinnae that are slightly or not reduced (vs. distal ones about ½ the size of the lower pinnae), and strongly asymmetric terminal pinnae (vs. symmetric) (Rojas-Alvarado and Tejero-Díez 2017).

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Authors' Contributions

Conceptualization: OOO. Data curation: ARA, YO, OOO. Formal analysis: ARA, OOO. Funding acqui-

Figure 3. Herbarium specimen of *Lindsaea leprieurii* from Coclé, Panama.

Figure 4. Geographical distribution of *Lindsaea leprieurii*. Square = new record from Panama; rhombi = previously known records.

sition: OOO. Investigation: YO, OOO. Methodology: OOO. Project administration: OOO. Supervision: ARA. Validation: ARA. Visualization: YO. Writing – original draft: YO, OOO. Writing – review and editing: ARA.

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